

## CLAIMS

What is claimed is:

- 1 1. A solar device comprising:
  - 2 a substrate;
  - 3 a multijunction solar cell structure having at least a first, second, and third
  - 4 subcells disposed over the substrate;
  - 5 a lateral conduction layer deposited over at least a portion of the multijunction
  - 6 solar cell structure; and
  - 7 a bypass diode having a p-type, i-type, and n-type layers, deposited over the
  - 8 lateral conduction layer.
- 1 2. The solar device of claim 1, further comprising a well in the multijunction
  - 2 solar cell structure to provide electrical separation between the subcells and the
  - 3 bypass diode.
- 1 3. The solar device of claim 2, further comprising a shunt having a first and
  - 2 second contacting ends, wherein the first contacting end of the shunt is connected the
  - 3 lateral conduction layer and the second contacting end of the shunt is connected to the
  - 4 substrate via the well.
- 1 4. The solar device of claim 1, further comprising a stop etch layer deposited
  - 2 over the lateral conduction layer.
- 1 5. The solar device of claim 1, further comprising a first and second contact
  - 2 layers, wherein the first contact layer is deposited adjacent the bypass diode and the
  - 3 second contact layer is disposed adjacent the substrate.
- 1 6. The solar device of claim 1, wherein the substrate is a germanium ("Ge")
  - 2 substrate.

1           7. The solar device of claim 6, wherein the multijunction solar cell structure is  
2 a triple junction solar cell.

1           8. The solar device of claim 7, wherein the first subcell is a bottom solar cell,  
2 the second subcell is a middle solar cell, and the third subcell is a top solar cell.

1           9. The solar device of claim 8, wherein the bottom solar cell further includes:  
2 a p-doped Ge base layer deposited over the Ge substrate;  
3 an n-doped Ge emitter layer deposited or formed by diffusion over the base  
4 layer; and  
5 an n-doped nucleation layer deposited over the emitter layer.

1           10. The solar device of claim 9, wherein the middle solar cell further includes:  
2 a p-doped back surface field ("BSF") layer deposited over the bottom solar  
3 cell;  
4 a p-doped gallium arsenic ("GaAs") base layer deposited over the BSF layer;  
5 an n-doped GaAs emitter layer deposited over the base layer; and  
6 an n-doped indium gallium phosphide<sub>2</sub> ("InGaP<sub>2</sub>") window layer deposited  
7 over the emitter layer.

1           11. The solar device of claim 10, wherein the top solar cell further includes:  
2 a p-doped indium gallium aluminum phosphide ("InGaAlP") back surface  
3 field ("BSF") layer deposited over the middle solar cell;  
4 a p-doped GaInP<sub>2</sub> base layer deposited over the InGaAlP BSF layer;  
5 an n-doped GaInP<sub>2</sub> emitter layer deposited over the InGaP<sub>2</sub> base layer; and  
6 an n-doped aluminum indium phosphide<sub>2</sub> ("AlInP<sub>2</sub>") window layer deposited  
7 over the GaInP<sub>2</sub> emitter layer.

1           12. The solar device of claim 11, further comprising a n-doped GaAs cap

2 layer deposited between the top solar cell and the lateral conduction layer.

1 13. The solar device of claim 12, wherein the lateral conduction layer is an n-  
2 doped GaAs layer for conducting electrical current.

1 14. The solar device of claim 1, wherein the p-type layer of the bypass diode  
2 is a p-doped GaAs layer and the n-type layer of the bypass diode is an n-doped GaAs  
3 layer.

1 15. The solar device of claim 14, wherein the i-type layer is a lightly doped  
2 GaAs layer for reducing defect breakdown.

1 16. The solar device of claim 14, wherein the i-type layer is an undoped GaAs  
2 layer for reducing defect breakdown.

1 17. A solar cell structure comprising:  
2 at least one solar cell disposed over a germanium ("Ge") substrate;  
3 a lateral conduction layer deposited over a portion of the solar cell structure;  
4 a bypass diode deposited over the lateral conduction layer; and  
5 a shunt having a first and second contacting sides formed between the solar  
6 cell and the bypass diode, wherein the first contacting side of the shunt is connected to  
7 the substrate and the second contacting side of the shunt is connected to the lateral  
8 conduction layer.

1 18. The solar cell structure of claim 17, further comprising a well situated  
2 between the solar cell and the bypass diode, wherein the well provides electrical  
3 separation between the solar cell and the diode.

1 19. The solar cell structure of claim 18, further comprising a stop etch layer

2 deposited over the lateral conduction layer.

1 20. The solar cell structure of claim 19, further comprising a first and second  
2 contact layers, wherein the first contact layer is deposited over the bypass diode and  
3 the second contact layer is disposed over the substrate.

1 21. The solar cell structure of claim 17, wherein the solar cell contains a  
2 bottom, middle, and top subcells.

1 22. The solar cell structure of claim 21, wherein the bottom subcell further  
2 includes:  
3 a Ge base layer deposited over the substrate;  
4 a Ge emitter layer deposited or formed by diffusion over the base layer; and  
5 a nucleation layer deposited over the emitter layer.

1 23. The solar cell structure of claim 22, wherein the middle subcell further  
2 includes:  
3 a back surface field ("BSF") layer deposited over the bottom solar cell;  
4 a gallium arsenic ("GaAs") base layer deposited over the BSF layer;  
5 a GaAs emitter layer deposited over the base layer; and  
6 an indium gallium phosphide<sub>2</sub> ("InGaP<sub>2</sub>") window layer deposited over the  
7 emitter layer.

1 24. The solar cell structure of claim 23, wherein the top subcell further  
2 includes:  
3 an indium gallium aluminum phosphide ("InGaAlP") back surface field  
4 ("BSF") layer deposited over the middle solar cell;  
5 a GaInP<sub>2</sub> base layer deposited over the InGaAlP BSF layer;  
6 a GaInP<sub>2</sub> emitter layer deposited over the InGaP<sub>2</sub> base layer; and

7 an aluminum indium phosphide<sub>2</sub> ("AlInP<sub>2</sub>") window layer deposited over the  
8 GaInP<sub>2</sub> emitter layer.

1 25. The solar cell structure of claim 24, further comprising a GaAs cap layer  
2 deposited between the top subcell and the lateral conduction layer.

1 26. The solar cell structure of claim 17, wherein the lateral conduction layer is  
2 an GaAs layer for transporting electrical current.

1 27. The solar cell structure of claim 17, wherein the bypass diode further  
2 includes an n-doped GaAs layer deposited over the lateral conduction layer and a p-  
3 doped GaAs layer deposited over the n-doped GaAs layer of the bypass diode.

1 28. The solar cell structure of claim 17, wherein the bypass diode further  
2 includes a p-doped GaAs layer deposited over the lateral conduction layer and an n-  
3 doped GaAs layer deposited over the p-doped GaAs layer of the bypass diode.

1 29. The solar cell structure of claim 28, wherein the bypass diode further  
2 includes an i-type layer, which is a lightly n-doped GaAs layer and deposited between  
3 the n-doped GaAs layer of the bypass diode and the p-doped GaAs layer of the bypass  
4 diode, for reducing defect breakdown.

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1 30. The solar cell structure of claim 28, wherein the bypass diode further  
2 includes an i-type layer, which is an undoped GaAs layer and deposited between the  
3 n-doped GaAs layer of the bypass diode and the p-doped GaAs layer of the bypass  
4 diode, for reducing defect breakdown.

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1 31. A method for manufacturing a solar device comprising:  
2 depositing a germanium ("Ge") substrate;

3 depositing a solar cell having multiple junctions on the Ge substrate;  
4 depositing a lateral conduction layer on the solar cell;  
5 depositing a bypass diode over the lateral conduction layer;  
6 etching a well between the bypass diode and the solar cell; and  
7 depositing a shunt between the Ge substrate and the bypass diode through the  
8 well, wherein one side of the shunt is connected to the Ge substrate and another side  
9 of the shunt is connected to the lateral conduction layer.

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1 32. The method of claim 31, further comprising depositing a stop etch layer  
2 between the lateral conduction layer and the bypass diode.

1 33. The method of claim 31, further comprising:  
2 depositing a first metal layer on the bypass diode for contact pad; and  
3 depositing a second metal layer on the Ge substrate for contact pad.

1 34. The method of claim 31, wherein depositing a bypass diode further  
2 including:  
3 depositing a n-doped gallium arsenic ("GaAs") base layer over the stop etch  
4 layer;  
5 depositing a i-doped GaAs layer over the n-doped GaAs base layer; and  
6 depositing a p-doped GaAs emitter layer over the i-doped GaAs layer.

1 35. The method of claim 31, wherein depositing a solar cell further includes:  
2 depositing a Ge-type bottom subcell including a nucleation layer;  
3 depositing a GaAs-type middle subcell over the bottom subcell; and  
4 depositing a GaInP<sub>2</sub>-type top subcell over the middle subcell.

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1 36. The method of claim 35, further comprising depositing a GaAs cap layer  
2 between the top subcell and the lateral conduction layer.